

## VACUUM PROCESSING APPARATUS

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## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

This invention relates to a vacuum processing apparatus and operating method therefor. More specifically, the present invention relates to a vacuum processing apparatus having vacuum processing chambers the inside of which must be cleaned, and its operating method.

## 2. Description of the Prior Art

In a vacuum processing apparatus such as a dry etching apparatus, a CVD apparatus or a sputtering apparatus, a predetermined number of substrates to be treated are stored as one unit (which is generally referred to as a "lot") in a substrate cassette and are loaded in the apparatus. The substrates after being processed are likewise stored in the same unit in the substrate cassette and are recovered. This is an ordinary method of operating these apparatuses to improve the productivity.

In such a vacuum processing apparatus described above, particularly in an apparatus which utilizes a reaction by an active gas, as typified by a dry etching apparatus and a CVD apparatus, reaction products adhere to and are deposited on a vacuum processing chamber with the progress of processing. For this reason, problems such as degradation of vacuum performance, the increase of dust, the drop of the levels of optical monitoring signals occur. To solve these problems, conventionally the insides of the vacuum processing chambers are cleaned periodically. Cleaning operations include so-called "wet cleaning" which is wiping-off of the adhering matters by use of an organic solvent, etc., and so-called "dry cleaning" in which an active gas or plasma is used for decomposing adhering matters. Dry cleaning is superior from the aspect of the working factor and efficiency. These features of the dry cleaning have become essential with the progress in automation of production lines.

An example of vacuum processing apparatuses having such a dry cleaning function is disclosed in Japanese Utility Model Laid-Open No. 127125/1988. This apparatus includes a preliminary vacuum chamber for introducing wafers to be treated into a processing chamber from an atmospheric side to a vacuum side, which is disposed adjacent to the processing chamber through a gate valve, dummy wafers are loaded in the preliminary vacuum chamber and are transferred into the processing chamber by exclusive conveyor means before the processing chamber is subjected to dry cleaning, and the dummy wafer is returned

to the vacuum preparatory chamber by the conveyor means after dry cleaning is completed.

## SUMMARY OF THE INVENTION

In the prior art technology described above, the structure of the vacuum processing apparatus is not much considered. The preliminary vacuum chamber for storing the dummy wafers must have a large capacity, the exclusive conveyor means is necessary for transferring the dummy wafers and thus, the apparatus is complicated in structure.

Dummy wafers used for plasma cleaning are again returned to the preliminary vacuum chamber and are made to stand by. In this instance, reaction products generated during plasma cleaning and residual gas used for plasma cleaning adhere on the used dummy wafers. Thereafter, normal processing for wafers is resumed. Therefore, the used dummy wafers and unprocessed wafers exist in mixture inside the preliminary vacuum chamber and this state is not desirable from the aspect of contamination of unprocessed wafers.

The present invention provides a vacuum processing apparatus which solves the problems described above, is simple in structure, prevents contamination of unprocessed substrates and accomplishes a high production yield. A vacuum processing apparatus having vacuum processing chambers the insides of which are dry-cleaned after substrates to be treated are processed in vacuum is provided with first storage means for storing substrates to be treated, second storage means for storing dummy substrates, the first and second storage means being disposed in the air, conveyor means for transferring the substrates to be processed between the first storage means and the vacuum processing chambers and for transferring the dummy substrates between the second storage means and the vacuum processing chambers, and control means for controlling the conveyor means so as to transfer the dummy substrates between the second storage means and the vacuum processing chambers before and after dry cleaning of the vacuum processing chambers. A method of operating a vacuum processing apparatus having vacuum processing chambers the insides of which are dry-cleaned after substrates to be processed are processed in vacuum comprises the steps of disposing first storage means for storing the substrates to be processed together with second storage means for storing dummy substrates in the air atmosphere, transferring the substrates to be processed between the first storage means and the vacuum processing chambers and vacuum-processing the substrates to be processed, and transferring the dummy substrates between the second storage means and the vacuum processing chambers before and after dry-cleaning of the vacuum processing chambers.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a dry etching apparatus as an embodiment of a vacuum processing apparatus in accordance with the present invention; and

FIG. 2 is a vertical sectional view taken along line 1—1 of FIG. 1

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

As substrates to be processed are processed in a vacuum processing apparatus, reaction products adhere to and are deposited in vacuum processing chambers. The reaction products adhering to and deposited in the vacuum process-

ing chambers are removed by disposing dummy wafers inside the vacuum processing chambers and by conducting dry-cleaning. To carry out dry cleaning, the timings of dry cleaning of the vacuum processing chambers are determined and during or after the processing of a predetermined number of substrates to be processed, dummy substrates are conveyed by substrate conveyor means from dummy substrate storage means disposed in the air atmosphere together with processed substrate storage means, and are then disposed inside the vacuum processing chambers. After the dummy substrates are thus disposed, a plasma is generated inside each of the vacuum processing chambers to execute dry-cleaning inside the vacuum processing chamber. After dry-cleaning inside the vacuum processing chambers is completed, the dummy substrates are returned from the vacuum processing chambers to the dummy substrate storage means by the substrate conveyor means. In this manner, a preliminary vacuum chamber and an exclusive transfer mechanism both necessary in prior art techniques become unnecessary, and the apparatus structure gets simplified. The dummy substrates used for the dry-cleaning and the substrates to be processed do not co-exist inside the same chamber, so that contamination of substrates to be processed due to dust and remaining gas is prevented and a high production yield can be achieved.

Hereinafter, an embodiment of the present invention will be explained with reference to FIGS. 1 and 2.

FIGS. 1 and 2 show a vacuum processing apparatus of the present invention which is, in this case, a dry-etching apparatus for etching wafers, i.e., substrates to be processed by plasma.

Cassette tables 2a to 2c are disposed in an L-shape in this case in positions such that they can be loaded into and unloaded from the apparatus without changing their positions and postures. In other words, the cassettes 1a to 1c are fixed always in predetermined positions on a substantially horizontal plane, while the cassette tables 2a and 2b are disposed adjacent to and in parallel with each other on one of the sides of the L-shape. The cassette table 2c is disposed on the other side of the L-shape. The cassettes 1a and 1b are for storing unprocessed wafers and for recovering the processed wafers. They can store a plurality (usually 25) of wafers 20 as the substrates to be treated. The cassette 1c in this case is for storing the dummy wafers for effecting dry-cleaning using plasma (hereinafter referred to as "plasma-cleaning") and recovering the dummy wafers after plasma-cleaning. It can store a plurality of (usually twenty-five pieces) dummy wafers 30.

A load lock chamber 5 and unload lock chamber 6 are so disposed as to face the cassette tables 2a and 2b, and a conveyor 13 is disposed between the cassette tables 2a, 2b and the load lock chamber 5 and the unload lock chamber 6. The load lock chamber 5 is equipped with an evacuating device 3 and a gas introduction device 4, and can load unprocessed wafers in the vacuum apparatus through a gate valve 12a. The unload lock chamber 6 is similarly equipped with the evacuating device 3 and the gas introduction device 4, and can take out processed wafers to the atmosphere through a gate valve 12d. The conveyor 13 is equipped with a robot having X, Y, Z and  $\theta$  axes, which operates so as to deliver and receive the wafers 20 between the cassettes 1a, 1b and the load lock and unload lock chambers 5 and 6 and the dummy wafers 30 between the cassette 1c and the load lock and unload lock chambers 5 and 6.

The load lock chamber 5 and the unload lock chamber 6 are connected to a transfer chamber 16 through the gate

valves 12b and 12c. The transfer chamber 16 is rectangular, in this case, and etching chambers 11a, 11b and 11c are disposed on the three side walls of the transfer chamber 16 through gate valves 15a, 15b and 15c, respectively. A conveyor 14 capable of delivering the wafers 20 or the dummy wafers 30 from the load lock chamber 5 to the etching chambers 11a, 11b, 11c and of delivering them from the chambers 11a, 11b, 11c to the unload lock chamber 6 is disposed inside the transfer chamber 16. The transfer chamber 16 is equipped with an evacuating device 17 capable of independent evacuation.

The etching chambers 11a, 11b, 11c have the same structure and can make the same processing. The explanation will be given on the etching chamber 11b by way of example. The etching chamber 11b has a sample table 8b for placing the wafers 20 thereon, and a discharge chamber is so provided as to define a discharge portion 7b above the sample table 8b. The etching chamber 11b includes a gas introduction device 10b for introducing a processing gas in the discharge portion 7b and an evacuating device 9b for decreasing the internal pressure of the etching chamber 11b to a predetermined pressure. The etching chamber 11b further includes generation means for generating a microwave and a magnetic field for converting processing gas in the discharge portion 7b to plasma.

A sensor 18 for measuring the intensity of plasma light is disposed at an upper part of the etching chamber. The measured value of the sensor 18 is inputted to a controller 19. The controller 19 compares the measure value from the sensor 18 with a predetermined one and determines the timing of cleaning inside the etching chamber. The controller 19 controls the conveyors 13 and 14 to control the transfer of the dummy wafers 30 between the cassette 1c and the etching chambers 11a to 11c.

In a vacuum processing apparatus having the construction described above, the cassettes 1a, 1b storing unprocessed wafers are first placed onto the cassette tables 2a, 2b by a line transfer robot which operates on the basis of the data sent from a host control apparatus, or by an operator. On the other hand, the cassette 1c storing the dummy wafers is placed on the cassette table 2c. The vacuum processing apparatus executes the wafer processing or plasma cleaning on the basis of recognition by itself of the production data provided on the cassette 1a to 1c, of the data sent from the host control apparatus, or of the command inputted by an operator.

For instance, the wafers 20 are sequentially loaded in the order from above into the etching chambers 11a, 11b, 11c by the conveyors 13 and 14, and are etched. The etched wafers are stored in their original positions inside the cassette 1a by the conveyors 14 and 13. In the case, from the start to the end of the operation, without changing the position and posture of the cassettes, the unprocessed wafers are taken out from the cassettes and are returned in their original positions where the wafers have been stored, and are stored there. In this manner, the apparatus can easily cope with automation of the production line, contamination of the wafers due to dust can be reduced and high production efficiency and high production yield can thus be accomplished.

As etching is repeated, the reaction products adhere to and are deposited on the inner wall of the etching chambers 11a to 11c. Therefore, the original state must be recovered by removing the adhering matters by plasma cleaning. The controller 19 judges the timing of this plasma cleaning. In this case, a portion through which the plasma light passes is provided in each of the etching chambers 11a to 11c. The

out in the air by the conveyor 13 through the gate valve 12d and is returned to its original position in the cassette 1c in which it is stored at the start.

Plasma cleaning is carried out in the following sequence. In this case, the explanation will be given about a case where the etching chambers 11a to 11c are subjected to plasma cleaning by using three dummy wafers 30 among the dummy wafers 30 (twenty-five dummy wafers are stored in this case) stored in the cassette 1c.

Dummy wafers **30** which are stored in the cassette **1c** and are not used yet or can be used because the number of times of use for plasma cleaning is below a predetermined one are drawn by the conveyor **13**. At this time, dummy wafers **30** stored in any position in the cassette **1c** may be used but in this case, the position numbers of the dummy wafers in the cassette and their number of times of use are stored in the controller **19**, and accordingly dummy wafers having smaller numbers of times of use are drawn preferentially. Then, the dummy wafers **30** are loaded in the load lock chamber **5** disposed on the opposite side to the cassette **1a** by the conveyor **13** through the gate valve **12a** in the same way as the transfer at the time of etching of wafers **20**. After the gate valve **12a** is closed, the load lock chamber **5** is evacuated to a predetermined pressure by the vacuum exhaust device **3** and then the gate valves **12b** and **15a** are opened. The dummy wafers **30** are transferred by the conveyor **14** from the load lock chamber **5** to the etching chamber **11a** through the transfer chamber **16** and are placed on the sample table **8a**. After the gate valve **15a** is closed, plasma cleaning is carried out in the etching chamber **11a** in which the dummy wafers **30** are disposed, under a predetermined condition.

In the interim, the gate valves *12a*, *12b* are closed and the pressure of the load lock chamber 5 is returned to the atmospheric pressure by the gas introduction device 4. Next, the gate valve *12a* is opened and the second dummy wafer 30 is loaded in the load lock chamber 5 by the conveyor 13 in the same way as the first dummy wafer 30, and evacuation is effected again by the evacuating device 3 to a predetermined pressure after closing the gate valve *12a*. Thereafter, the gate valves *12b* and *15b* are opened and the second dummy wafer 30 is transferred from the load lock chamber 5 to the etching chamber 11b through the transfer chamber 16 by the conveyor 14. Plasma cleaning is started after the gate valve *15b* is closed.

In the interim, the third dummy wafer 30 is transferred into the etching chamber 11c in the same way as the second dummy wafer 30 and plasma cleaning is carried out.

After plasma cleaning is completed in the etching chamber 11a in which the first dummy wafer 20 is placed, the gate valves 15a and 12c are opened. The used dummy wafer 30 is transferred from the etching chamber 11a to the unload lock chamber 6 by the conveyor 14. Then, the gate valve 12c is closed. After the pressure of the unload lock chamber 6 is returned to the atmospheric pressure by the gas introduction device 4, the gate valve 12d is opened. The used dummy wafer 30 transferred to the unload lock chamber 6 is taken

In this way, the used dummy wafers 30 are returned to their original positions in the cassette 1c and the dummy wafers 30 are always stocked in the cassette 1c. When all the dummy wafers 30 in the cassette 1c are used for plasma cleaning or when the numbers of times of use of the wafers 30 reach the predetermined ones after the repetition of use, the dummy wafers 30 are replaced as a whole together with the cassette 1c. The timing of this replacement of the cassette is managed by the controller 19 and the replacement is instructed to the host control apparatus for controlling the line transfer robot or to the operator.

Although the explanation given above deals with the case where the etching chambers 11a to 11c are continuously plasma-cleaned by the use of three dummy wafers 30 among the dummy wafers 30 in the cassette 1c, other processing methods may be employed, as well.

For example, the etching chambers 11a to 11c are sequentially plasma-cleaned by the use of one dummy wafer 30. In the case of such plasma cleaning, unprocessed wafers 20 can be etched in etching chambers other than the one subjected to plasma cleaning, and plasma cleaning can thus be carried out without interrupting etching.

If the processing chambers are different, for example, there are an etching chamber, a post-processing chamber and a film-formation chamber, and wafers are sequentially processed while passing through each of these processing chambers, each of the processing chambers can be subjected appropriately to plasma cleaning by sending dummy wafers 30 during the processing of the wafers 20 which are stored in the cassette 1a or 2a and drawn and sent sequentially, by passing merely the dummy wafers 30 through the processing chambers for which plasma cleaning is not necessary, and by executing plasma cleaning only when the dummy wafers 30 reach the processing chambers which need plasma cleaning.

According to the embodiment described above, the cassette storing the dummy wafers and the cassettes storing the wafers to be processed are disposed together in the air, the dummy wafers are loaded from the cassette into the apparatus by the same conveyor as the conveyor for transferring the wafers, at the time of cleaning, and the used dummy wafers are returned to their original positions in the cassette. In this way, a mechanism for conducting exclusively plasma cleaning need not be provided, and the construction of the apparatus can be simplified. It is not necessary to handle plasma cleaning as a particular processing sequence, but the plasma cleaning can be incorporated in an ordinary etching processing and can be carried out efficiently in a series of operations.

The dummy wafers used for plasma cleaning are returned to their original positions in the cassette placed in the air. Accordingly, the used dummy wafers and the wafers before and after processing do not exist mixedly in the vacuum chamber, so that contamination of wafers due to dust and remaining gas does not occur unlike conventional apparatuses.

The used dummy wafers are returned to their original positions in the cassette and the numbers of times of their use is managed. Accordingly, it is possible to prevent the confusion of the used dummy wafers with the unused dummy wafers and the confusion of the dummy wafers

7

having small numbers of times of use with the dummy wafers having large numbers of times of use. For these reasons, the dummy wafers can be used effectively without any problem when plasma cleaning is carried out.

Furthermore, in accordance with the present invention, the apparatus can have a plurality of processing chambers and can transfer wafers and dummy wafers by the same conveyor. Since plasma cleaning can be carried out by managing the timing of cleaning of each processing chamber by the controller, the cleaning cycle can be set arbitrarily, dry cleaning can be carried out without interrupting the flow of the processing, the processing can be effectively made and the productivity can be improved.

As described above, according to the present invention, there are effects that the construction of the apparatus is simple, the substrates to be processed are free from contamination and the production yield is high.

What is claimed is:

1. A conveyor system for use in vacuum processing apparatus comprising:

a cassette mount unit, provided with a cassette, for receiving plural substrates to be processed;

a conveyor loader having a first conveyor unit for conveying substrates to be processed;

a load lock chamber for receiving said substrates to be processed from said first conveyor unit;

an unload lock chamber for delivering said substrates, which have been processed, to said first conveyor unit, said unload lock chamber being a separate chamber from said load lock chamber, and

a vacuum conveyor load unit, having a conveyor chamber, and comprising a second conveyor unit, which conveys said substrates to be processed between said load lock chamber or said unload lock chamber and at least one of a plurality of vacuum processing chambers, wherein: said conveyor loader is disposed in front of the load lock chamber and the unload lock chamber, between the cassette mount unit and the two lock chambers, and the substrates are loaded and unloaded between said cassette and the plurality of vacuum processing chambers, and said plural vacuum processing chambers treat said substrates with surfaces thereof which are treated being kept horizontal

2. A conveyor system for use in a vacuum processing apparatus, comprising:

a cassette mount unit provided with plural cassettes for receiving plural substrates to be processed;

a conveyor loader having a first conveyor unit for conveying said substrates,

a load lock chamber for receiving said substrates to be processed from said first conveyor unit,

an unload lock chamber for delivering said substrates which have been processed, to said first conveyor unit, said unload lock chamber being a separate chamber from said load lock chamber, and the first conveyor unit passing the substrates in a first direction when conveying said substrates to be processed to the load lock chamber and passing said substrates in a second direction opposite the first direction when passing substrates from the unload lock chamber, and

a vacuum conveyor load unit, having a conveyor chamber, and comprising a second conveyor unit, which conveys the substrates between said load lock chamber or said unload lock chamber and at least one of a plurality of vacuum processing chambers, wherein:

8

said conveyor loader is disposed in front of the load and unload lock chambers, between the cassette mount unit and the two lock chambers, and

the substrates are loaded and unloaded between said cassettes and the plurality of vacuum processing chambers, and said plural vacuum processing chambers treat said substrates with surfaces thereof which are treated being kept horizontal

3. A conveyor system according to claim 2, wherein said vacuum processing chambers carry out plural processing selected from the group consisting of dry etching, chemical vapor deposition and sputtering

4. A conveyor system for use in a vacuum processing apparatus, comprising:

a cassette mount unit for receiving plural substrates to be processed, and for receiving substrates which have been processed;

a conveyor loader having a first conveyor unit for conveying said substrates;

a load lock chamber for receiving said substrates from said first conveyor unit;

an unload lock chamber for delivering a substrate, of said substrates, which has been processed, to said first conveyor unit, said unload lock chamber being a separate chamber from said load lock chamber, and the cassette mount unit being positioned in front of said load lock chamber or said unload lock chamber; and

a vacuum conveyor load unit, having a conveyor chamber, and comprising a second conveyor unit which conveys said substrates between said load lock chamber or said unload lock chamber and at least one of a plurality of vacuum processing chambers,

each of said plurality of vacuum processing chambers having a substrate table to maintain surfaces of said substrates, which are processed, horizontal during a vacuum processing,

said conveyor loader being disposed in front of the load and unload lock chambers between the cassette mount unit and the load and unload lock chambers,

the substrates being loaded and unloaded between said cassettes and the plurality of vacuum processing chambers, and

said plurality of vacuum processing chambers treating said substrates with surfaces thereof which are treated being kept horizontal.

5. A conveyor system for use in a vacuum processing apparatus, comprising:

a transfer device arranged so as to access plural cassettes and plural lock chambers,

a cassette table arranged to direct a wafer takeout port of said plural cassettes toward a side of said transfer device, the cassette table being located so as to position the cassettes in front of said plural lock chambers,

said plural lock chambers, having gate valves directed toward said transfer device, and comprising a load lock chamber and an unload lock chamber, and

a vacuum buffer chamber having plural gate valves at a surrounding portion which are disposed to enable plural vacuum processing chambers to be connected with said plural lock chambers,

wherein said transfer device is disposed in front of the plural lock chambers between the cassette table and said plural lock chambers,

wherein each of the lock chambers is provided with both an inlet and an outlet located in a horizontal line,

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9

wherein another transfer device is provided in said vacuum buffer chamber and is provided with an arm extendable into the double lock chambers and across inlets to the plural vacuum processing chambers, so as to support substrates with surfaces thereof which are treated being kept horizontal, such that said plural vacuum processing chambers treat said substrates with the surfaces being horizontal, and

wherein the substrates are sequentially loaded and unloaded in order between the cassettes and said plural vacuum chambers

6 Apparatus for carrying out a method including steps of:

(i) placing a cassette containing wafers to be processed at a cassette table,

(ii) loading said wafers sequentially in order from said cassette by means of a conveyor and a load lock chamber; and

(iii) unloading processed wafers by means of an unload lock chamber and said conveyor,

said apparatus comprising:

a first loader provided with a conveying structure for conveying the wafers,

a second loader provided with a convey chamber, another conveying structure and plural vacuum processing chambers,

said cassette table, for disposing cassettes containing wafers to be processed, the cassettes being disposed in a single row in front of said load and unload lock chambers; and

said load and unload lock chambers, in which wafers are transferred from an atmosphere to vacuum and from vacuum to the atmosphere,

wherein said conveying structure is adapted to transfer wafers between a cassette at said cassette table and said load and unload lock chambers, to transfer wafers from said cassette to said load lock chamber and from said unload lock chamber to said cassette,

wherein said conveying structure is disposed in front of said load and unload lock chambers, between the cassettes and the load and unload lock chambers,

wherein each of the lock chambers is provided with both an inlet and an outlet located in a horizontal line,

wherein each of said plural vacuum processing chambers has a wafer table to maintain horizontal a surface of a substrate which is treated during a vacuum processing, so that the surfaces treated in the plural vacuum processing chambers are horizontal during the vacuum processing,

wherein the substrates are sequentially transferred one by one from said first loader to said second loader and from said second loader to said first loader through said lock chambers,

wherein the wafers are one by one loaded and unloaded from cassettes into said plural vacuum processing chambers, and

wherein in said vacuum processing chamber, a processing selected from the group consisting of dry etching, chemical vapor deposition and sputtering is performed

7 A vacuum processing apparatus, comprising:

a first loader provided with a conveying structure for conveying substrates;

a second loader provided with a convey chamber, another conveying structure and plural vacuum processing chambers; and lock chambers for connecting said first loader and said second loader, wherein:

10

said first loader includes a cassette mount unit located outside of said lock chambers, and

said cassette mount unit has a cassette positioning plane in which all cassettes, containing samples to be processed, are positioned in a single row in front of said lock chambers,

said first loader is disposed in front of said lock chambers between the cassette mount unit and said lock chambers,

said lock chambers are respectively provided with gate valves respectively at both an inlet and an outlet located in a horizontal line, and

said vacuum processing chambers carry out a processing selected from the group consisting of dry etching, chemical vapor deposition and sputtering

8. A vacuum processing apparatus, comprising:

a first loader provide with a conveying structure for conveying substrates,

a second loader provided with a convey chamber, another conveying structure and plural vacuum processing chambers, and

lock chambers for connecting said first loader and said second loader,

wherein

said first loader includes a cassette mount unit located outside of said lock chambers,

said cassette mount unit has a cassette positioning plane in which all cassettes, containing substrates to be processed, are positioned in a single row in front of said lock chambers,

said first loader is disposed in front of a front wall of said lock chambers between the cassette mount unit and said lock chambers,

said lock chambers are respectively provided with both an inlet and an outlet located in a horizontal line,

said substrates are loaded and unloaded between the cassettes and said plural vacuum chambers,

said substrates are treated in said plural vacuum processing chambers with surfaces of the substrates which are treated being kept horizontal. and

said plural vacuum processing chambers carry out a processing selected from the group consisting of dry etching, chemical vapor deposition and sputtering

9. A vacuum processing apparatus, comprising:

a first loader provided with a conveying structure for conveying substrates;

a second loader provided with a convey chamber, another conveying structure and plural vacuum processing chambers, and

lock chambers for connecting said first loader and said second loader,

wherein

said first loader includes a cassette mount unit located outside of said lock chambers,

said cassette mount unit has a cassette positioning plane in which all cassette, containing substrates to be processed, are positioned in a single row in front of said lock chambers,

said first loader is disposed in front of a front wall of the lock chambers, between said cassette mount unit and said lock chambers,

said lock chambers are provided with both an inlet and an outlet located in a horizontal line,

the substrates are transferred from said first loader to said second loader and from said second loader to said first loader through said lock chambers,